A project report on

Independent E-ticketing System For Public Transport

Submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF COMPUTER ENGINEERING

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(2022-2023)

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CERTIFICATE

This is to certify that the Mini Project entitled "**Independent E-ticketing System For Public Transport**" is a bonafide work of **Azeeiim Khan (20102071), Prathamesh Mane (20102052), Dhyey Patel (20102193), Aman Kashyap (20102183)** submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of Bachelor of Engineering in Computer Engineering

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Project Report Approval for Mini Project-2B

This project report entitled "**Independent E-ticketing System For Public Transport"** by ***Dhyey Patel, Mohamad Azeeiim Khan, Prathamesh Mane, Aman Kashyap*** is approved for the partial fulfillment of the degree of ***Bachelor of Engineering*** in ***Computer Engineering***, ***2022-23***.

Examiner Name	Signature
1. _____	_____
2. _____	_____

Date:

Place:

DECLARATION

We declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will cause disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

An independent e-ticketing system for public transport is a digital system that allows passengers to purchase and use tickets electronically for various modes of public transportation. This system aims to provide a convenient and efficient ticketing experience to passengers while reducing the need for physical ticket sales and handling. The system is designed to operate independently of any specific transportation provider, allowing for seamless integration with different transportation modes and operators. The e-ticketing system utilizes various technologies such as mobile applications, smart cards, and contactless payment methods to provide a wide range of ticketing options for passengers. Additionally, the system can provide real-time information about transportation schedules, routes, and delays, enabling passengers to plan their journeys more effectively. The independent e-ticketing system offers numerous benefits, including reduced transaction time and costs, improved passenger experience, and increased revenue for transportation providers.

Keywords: “E-ticketing”, “Public Transport”, “Digital System” ,“Contactless Payments”

CONTENTS

LIST OF FIGURES

Chapter 1

INTRODUCTION

Public transportation plays a significant role in many countries worldwide, providing millions of people with access to work, education, healthcare, and other essential services. However, the traditional paper-based ticketing system used by most public transportation providers is often inconvenient, inefficient, and prone to errors. This has led to a growing demand for independent e-ticketing systems that offer passengers a more seamless and convenient ticketing experience while reducing the need for physical ticket sales and handling.

An independent e-ticketing system for public transport is a digital platform that allows passengers to purchase and use tickets electronically for various modes of public transportation, including buses, trains, trams, and ferries. This system is designed to operate independently of any specific transportation provider, allowing for seamless integration with different transportation modes and operators. The e-ticketing system utilizes various technologies such as mobile applications, smart cards, and contactless payment methods to provide a wide range of ticketing options for passengers.

The traditional paper-based ticketing system used in public transportation is often associated with long queues, delays, and human errors, leading to frustration among passengers. The independent e-ticketing system offers a more streamlined and efficient ticketing experience, enabling passengers to purchase tickets online or via mobile applications and use them directly on their smartphones or smart cards. This system also offers various payment options, including credit cards, debit cards, and mobile payments, making it easier for passengers to purchase tickets.

The independent e-ticketing system offers numerous benefits to both passengers and transportation providers. For passengers, the system offers a more convenient, faster, and seamless ticketing experience, eliminating the need to carry cash or wait in long queues to purchase tickets. Passengers can easily purchase tickets online, top-up their smart cards, and access real-time information on transportation schedules, routes, and delays. This makes it easier for passengers to plan their journeys and avoid delays and disruptions.

For transportation providers, the independent e-ticketing system offers a range of benefits, including increased revenue, reduced transaction costs, and improved passenger experience. The system enables transportation providers to collect more accurate and timely data on passenger travel patterns, helping them to optimize routes and improve service quality.

Additionally, the system eliminates the need for physical ticket sales and handling, reducing costs associated with printing, distribution, and collection of paper tickets.

The independent e-ticketing system also offers several environmental benefits, as it reduces the use of paper tickets, thus reducing paper waste and carbon emissions associated with ticket production and distribution. Additionally, the system can enable transportation providers to optimize routes and reduce idle times, leading to reduced fuel consumption and lower emissions.

In conclusion, the independent e-ticketing system for public transport offers a convenient, efficient, and cost-effective ticketing solution for passengers and transportation providers. The system utilizes various technologies, including mobile applications, smart cards, and contactless payment methods, to provide passengers with a wide range of ticketing options and real-time information on transportation schedules, routes, and delays. The system offers numerous benefits, including improved passenger experience, increased revenue for transportation providers, and reduced transaction costs. The independent e-ticketing system is also environmentally friendly, reducing paper waste and carbon emissions associated with traditional paper ticketing systems.

Chapter 2
Literature Survey

The concept of e-ticketing has been around for several years, but its implementation in the context of public transport is relatively new. The following literature review highlights some of the key research and findings related to independent e-ticketing systems for public transport.

[1] Upendra Reddy, C., Vara Prasad Reddy, D. L. S., Srinivasan, N., & Albert Mayan, J. (2019). *Bus Ticket System for Public Transport Using QR Code.*

The paper proposes a bus ticketing system for public transportation using QR codes. The system is aimed at reducing the use of paper tickets and increasing the efficiency of the ticketing process. Passengers can generate a QR code ticket on their mobile devices and the code can be scanned by the bus conductor to validate the ticket. The system is designed to be secure and prevent ticket fraud. The authors suggest that the system has the potential to improve the overall bus ticketing experience for passengers and operators alike.

[2] Kazi, S., Bagasrawala, M., Shaikh, F., & Sayyed, A. (2018). *Smart E-Ticketing System for Public Transport Bus. 2018 International Conference on Smart City and Emerging Technology (ICSCET).*

This paper proposes a smart e-ticketing system for public transportation buses to address the issues of ticket fraud and revenue losses. The proposed system includes a centralized database to store passenger and trip details, a mobile application for passengers to purchase and validate tickets, and a web application for bus operators to manage and monitor the system. The system uses RFID and GPS technologies to ensure the accuracy of passenger and trip data. The authors claim that the proposed system can enhance the efficiency of the ticketing process, reduce fraud, and increase revenue for bus operators.

[3] Eddy Soeryanto Soegoto, Rudy Setiawan, Rizky Jumansyah , Impact of E-Ticketing Application on Bus Transportation in Bandung.

This study used qualitative methods to examine the impact of e-ticketing on public transportation in Bandung. Results indicated that the implementation of e-ticketing had positive impacts on public transport, such as increased interest and reduced traffic congestion. The system provides convenience and comfort for passengers and transportation providers, encouraging the use of public transport for daily activities. Overall, the findings suggest that e-ticketing has the potential to improve the efficiency and sustainability of public transportation in Bandung.

[4] Oloyede, M.O.,Alaya S.M,Adewole, K.S.,Development of an Online Bus Ticket Reservation System for a Transportation Service in Nigeria.

This paper proposes a web-based bus reservation system to address the issue of manual bus reservation in Nigeria and other countries. The system allows visitors to check bus availability, purchase and pay for bus tickets online, using XHTML, PHP, SQL, Ajax, CSS, and JavaScript. By improving the efficiency and convenience of bus reservation, the system aims to boost the growth of the bus travel industry in the country. Leveraging modern web technologies, the proposed system offers a streamlined and user-friendly approach to bus reservation. Overall, the paper highlights the potential of technology to transform and improve the efficiency of the transportation industry in Nigeria and beyond.

Another challenge is user acceptance and trust. As noted by Liu et al. (2016) and Kim et al. (2018), the success of e-ticketing systems depends on the willingness of users to adopt and use them. This requires effective communication and education, as well as user-centered design and a positive user experience.

Overall, the literature suggests that independent e-ticketing systems for public transport have the potential to significantly improve the efficiency and effectiveness of public transport operations, as well as enhance the customer experience. However, their implementation requires careful consideration of interoperability, standardization, user acceptance, and trust. Further research is needed to explore these issues in more detail, as well as to examine the long-term impact of e-ticketing systems on public transport networks and society as a whole.

Research Paper	ANALYSIS
[1] Upendra Reddy, C., Vara Prasad Reddy, D. L. S., Srinivasan, N., & Albert Mayan, J. (2019). *Bus Ticket System for Public Transport Using QR Code.*	To generate tickets using QR code and payment through wallet. The system is aimed at reducing the use of paper tickets and increasing the efficiency of the ticketing process.This system secures and prevents fraud.
[2] Kazi, S., Bagasrawala, M., Shaikh, F., & Sayyed, A. (2018). *Smart E-Ticketing System for Public Transport Bus. 2018 International Conference on Smart City and Emerging Technology (ICSCET)*.	The user can check the availability of the seats, book tickets and check the expected waiting time.system includes a centralized database to store passenger and trip details, a mobile application for passengers to purchase and validate tickets.
[3] Eddy Soeryanto Soegoto, Rudy Setiawan, Rizky Jumansyah , Impact of E-Ticketing Application on Bus Transportation in Bandung	Proposing QR-based bus ticket generation and wallet based payment for streamlined bus reservation.
[4]Oloyede, M.O.,Alaya S.M,Adewole, K.S.,Development of an Online Bus Ticket Reservation System for a Transportation Service in Nigeria.	The system allows you to check the seat facebook tickets and view the expected waiting time.

Chapter 3

Problem Statement, Scope, Objective

3.1 Problem Statement:-

To implement local ways of booking tickets in the bus system .Sometimes, the buses are so crowded and the travel distance is so small that getting a ticket results in chaos.Finding the conductor and getting a ticket in crowded buses is the biggest problem in peak hours.In some cases, it is possible that both the commuter and conductor do not have the required change.

Description:-

To create a Bus ticketing system where admin can add buses and the users can book tickets according to their destination and view the generated ticket.Providing change is also an essential solution to this problem. Bus companies could make sure that conductors always have sufficient change available to avoid situations where commuters cannot purchase tickets due to a lack of change. This would help to prevent long lines and reduce frustration among commuters. It would also help conductors to work more efficiently by avoiding the need to search for change or make change.

The bus ticketing system is developed to ease the problem of booking tickets for the passengers as sometimes it becomes a huge task for generating the ticket. The system provides an effective means for the users as they can possibly generate tickets according to their routes.The Admin user present schedules various buses according to their routes dynamically.

3.2 Objective

- The main objective is to generate a ticket by scanning the QR code which is placed inside the bus.
- The wallet will consist of T-coins that will help reduce the chances of transaction failures in real time.
- In this app, after registration of profile the user needs to add Credits(T-Coins) into the Wallet.
- Using these coins the user will be able to perform the required transactions.

3.3 Scope

- The passenger can use the QR code scanner to display the bus details.
- Payment for the ticket can be done using T-coins present in the wallet.
- Administrator (i.e. Bus Driver/Conductor) provides the Bus route for the specified bus number.
- Generation of Digital Ticket depending on the route entered by the passenger.

Chapter 4

Proposed System Architecture

4.1 Description about Proposed System:

- The first step in this process is for the admin to add the locality in which the buses will run. This could involve creating a list of all the localities where the bus service operates, along with the routes and schedules for each bus. This information will be crucial for users who are trying to book tickets, as it will help them find the right bus for their needs.
- Once the admin has added the locality, the buses will be added to the respective locality by the admin. This could involve assigning each bus to a specific route and setting its schedule. It may also involve adding information about the capacity of each bus, so that users can see how many seats are available on each trip.
- After this, the user can create their account by registering themselves on the app. This typically involves providing their name, contact details, and other personal information. Once the registration is done successfully, the user can then log in to the app to purchase bus tickets according to their needs.
- Once the user logs into the app, they will be prompted to enter the boarding stop and destination where they want to reach. This information will be used to generate a ticket that contains all the details, including the booking time of the ticket and the user's details.
- When the user clicks on the ticket, they will be able to add the number of travelers who will be accompanying them. This is important because it helps the app to determine how many seats are needed for each trip.
- Once the user has added the number of travelers, they will need to make the final payment for purchasing the ticket. This typically involves selecting a payment method and entering their payment details. The app will then generate a confirmation message that contains all the relevant information about the ticket, including the trip details, the amount paid, and any other important information.
- The generated ticket can be viewed by the user as well as by the admin. This allows both parties to keep track of the ticket and ensure that everything is in order.
- Overall, the bus ticket booking application flow you described is a basic but essential process that ensures users can quickly and easily book tickets for their desired destination. By following this flow, the app can provide a streamlined and user-friendly experience that allows users to book their tickets in just a few simple steps.

4.2 Architecture / Block Diagram

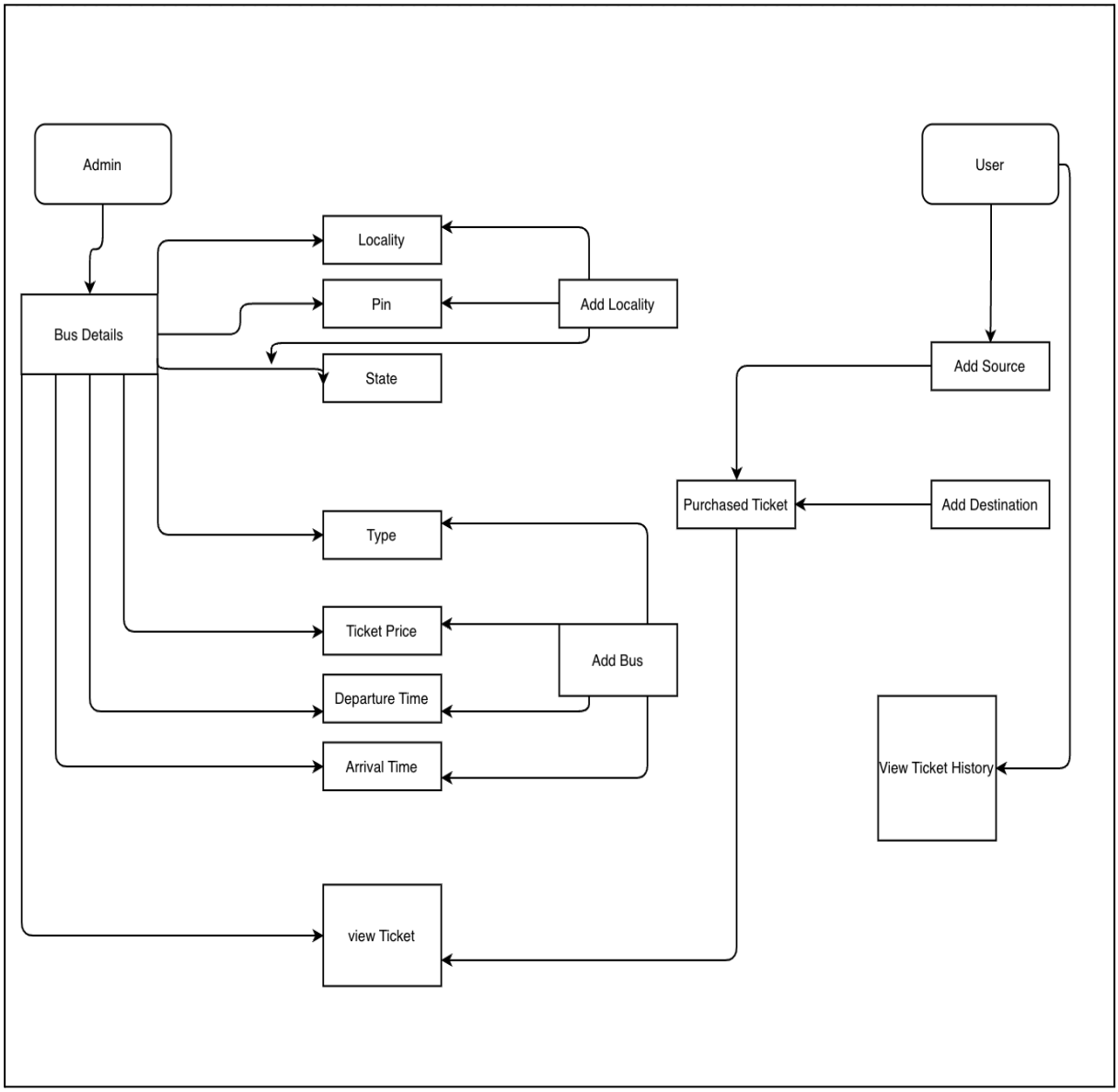

Fig. 4.2 Architecture Diagram

The software architecture diagram is a visual presentation of all of the aspects that constitute a system, either in part or whole. It is a depiction of a set of concepts that comprise architecture, such as its principles, components, and materials. It is also a system diagram used to abstract the general layout of the software system as well as the interactions, limitations, and limits between parts.

4.3 Data Flow Diagram (Level 0, Level 1 & Level 2)

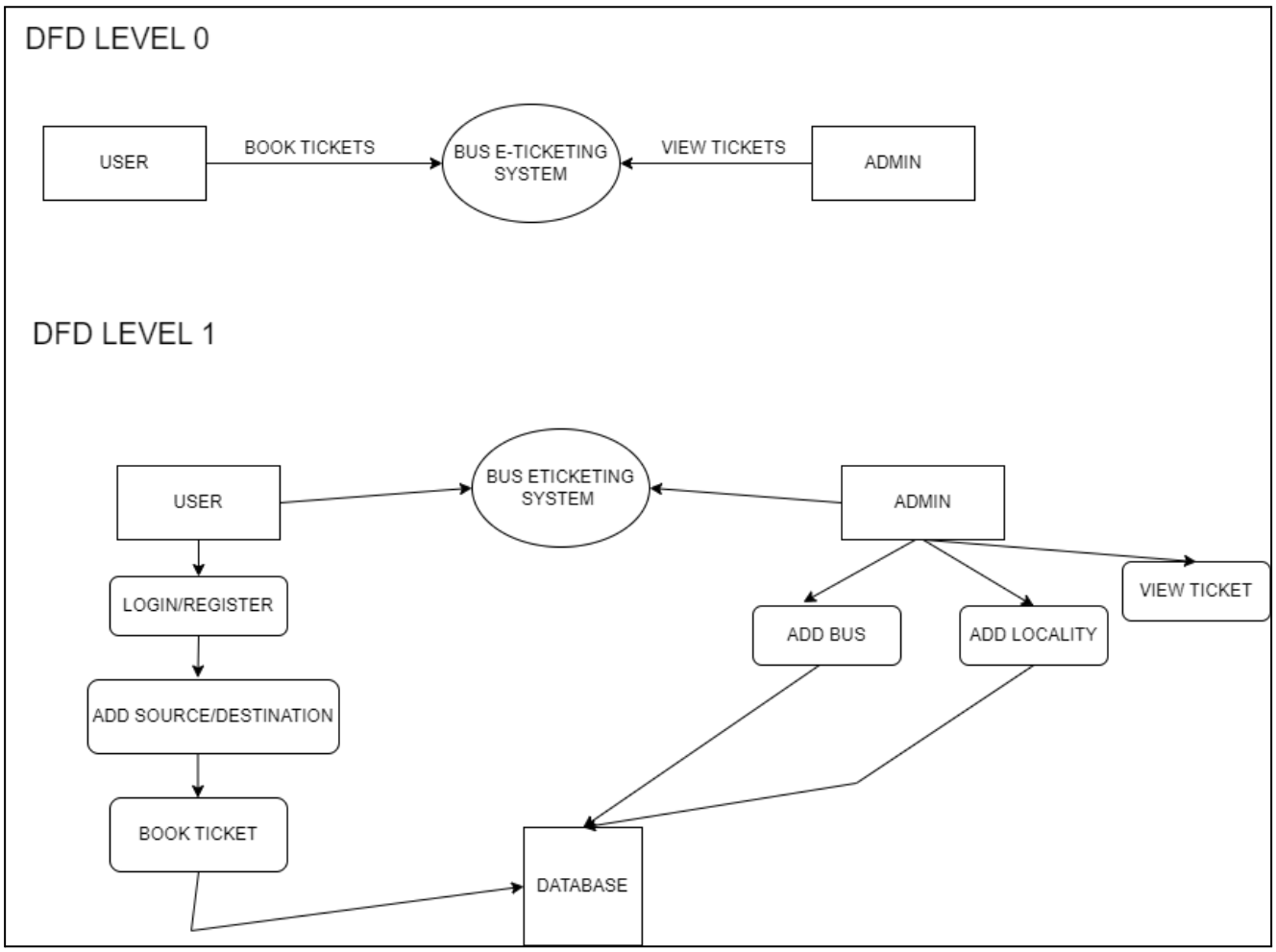

Fig 4.3. DFD LEVEL 0 & 1

Level 0 DFD is a basic representation of a particular software. This level includes only the main structure of the software. This level is not refined as other levels of the data flow diagram

To know more details about the software we update from level 0 DFD to level 1 DFD. Level 1 DFD tells us about each and every functionality present in the software. It is bigger in size in comparison with level 0 DFD. In 1-level DFD, the context diagram is decomposed into multiple bubbles/processes. In this level, we highlight the main functions of the system and breakdown the high-level process of 0-level DFD into subprocesses.

DFD LEVEL 2

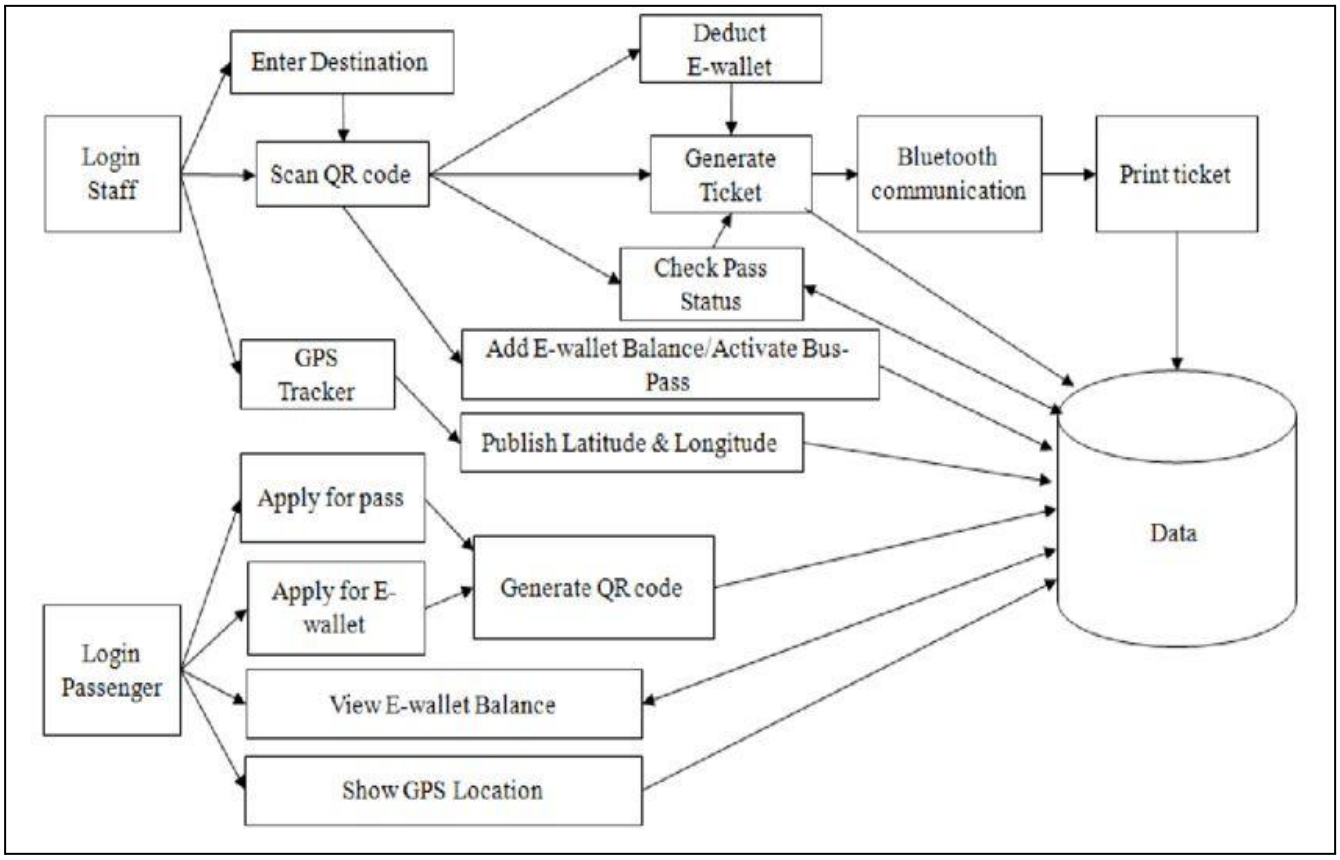

Fig 4.3 . DFD LEVEL 2

In order to know more details about the software we update from level 1 DFD to level 2 DFD. Level 2 DFD tells us more about each and every functionality present in the software. It is bigger in size in comparison with level 1 DFD. In 1-level DFD, the context diagram is decomposed into multiple bubbles/processes.

4.4 Use Case Diagram

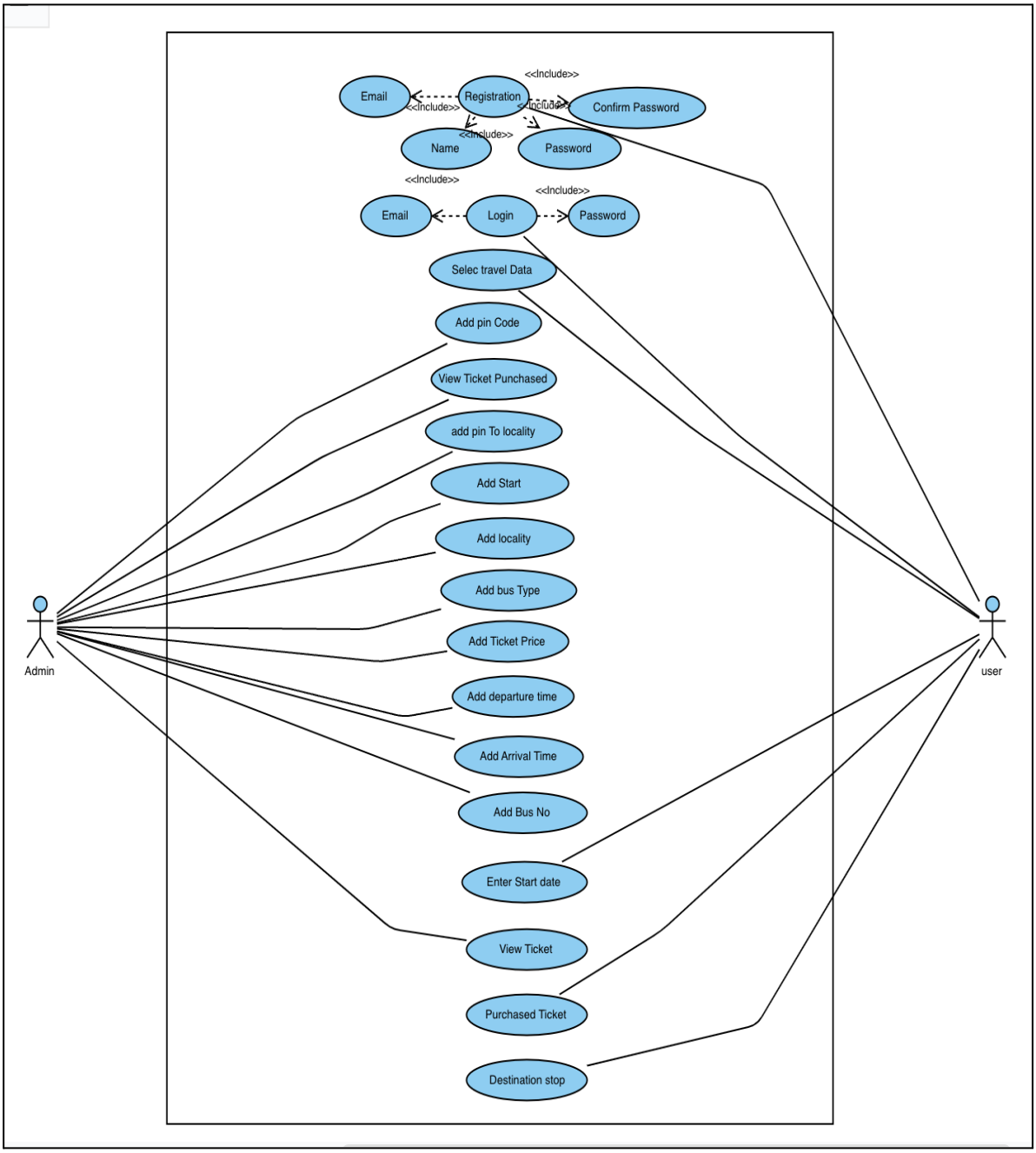

Fig. 4.4 Use Case Diagram

A use case diagram is the primary form of system/software requirements for a new software program underdeveloped. Use cases once specified can be denoted by both textual and visual representation.. When a use case is depicted as using the functionality of another use case, the relationship between the use cases is named as <> or uses relationship. The stereotype "<>" identifies as an extend relationship

4.5 Activity Diagram

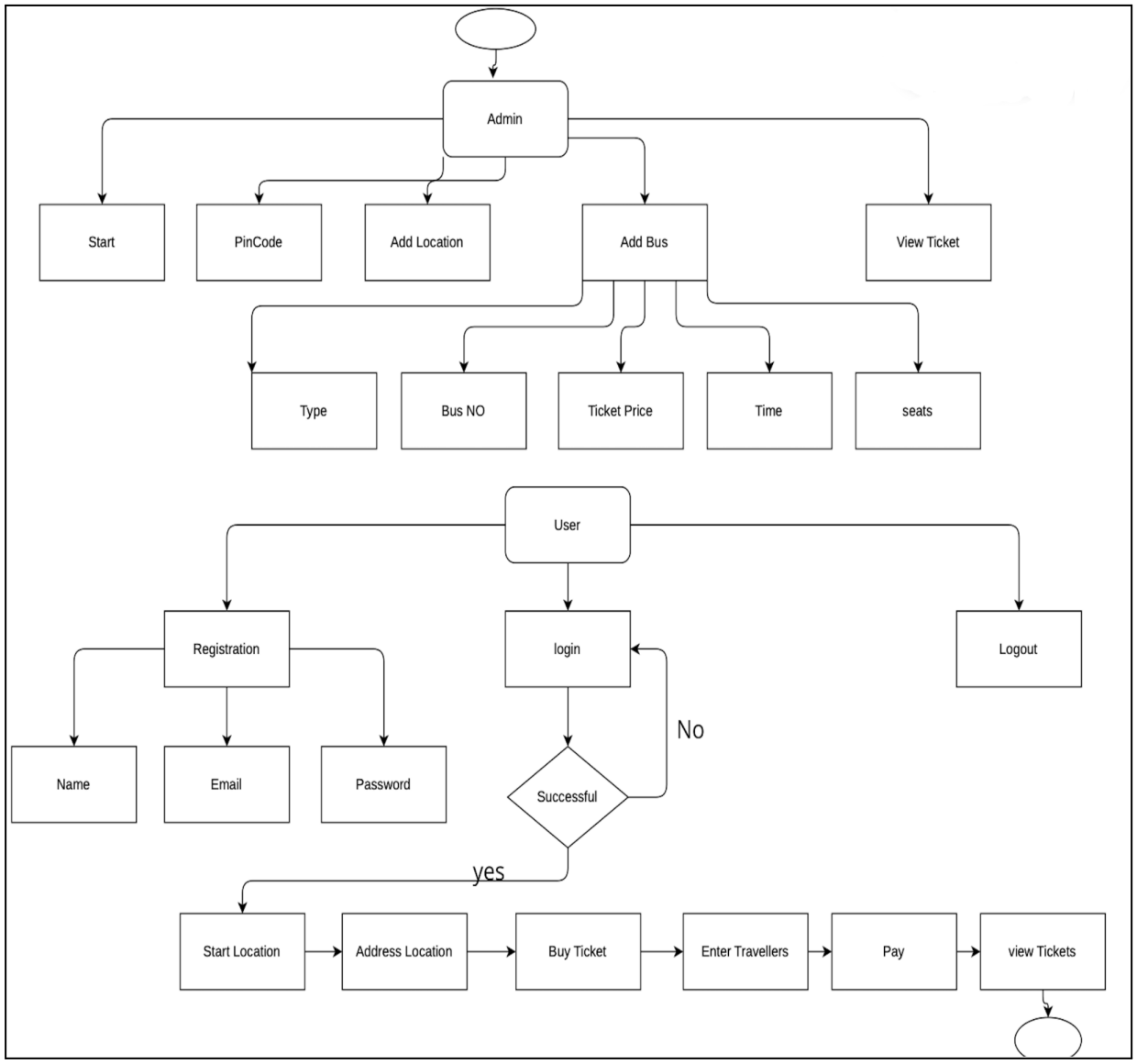

Fig. 4.5 Activity Diagram

The activity diagram is another important behavioral diagram in UML diagram to describe dynamic aspects of the system. An activity diagram is essentially an advanced version of flowchart that models the flow from one activity to another activity.

4.6 : Flowchart

Admin:

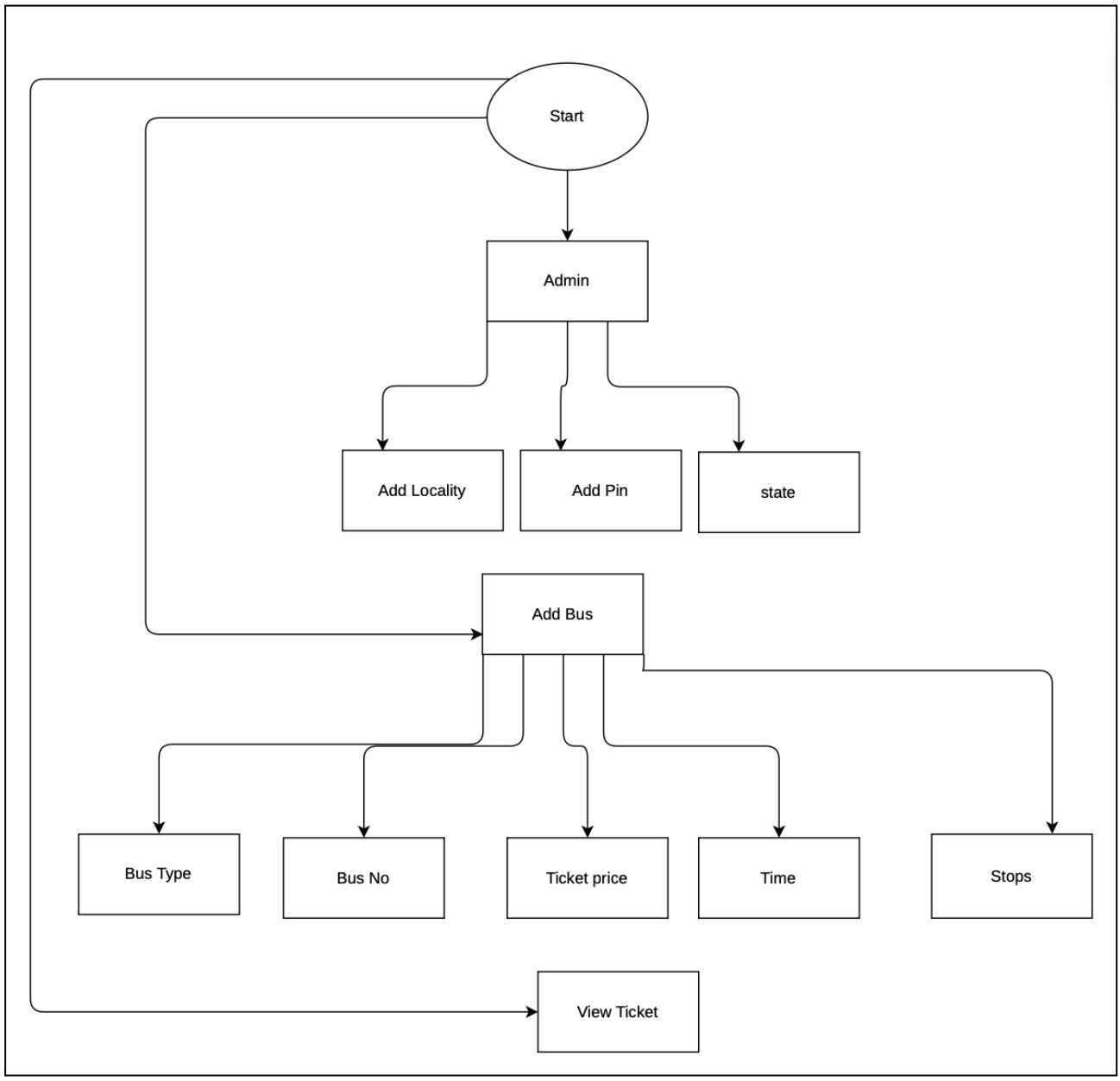

Fig. 4.6.1 Flowchart (Admin)

User:

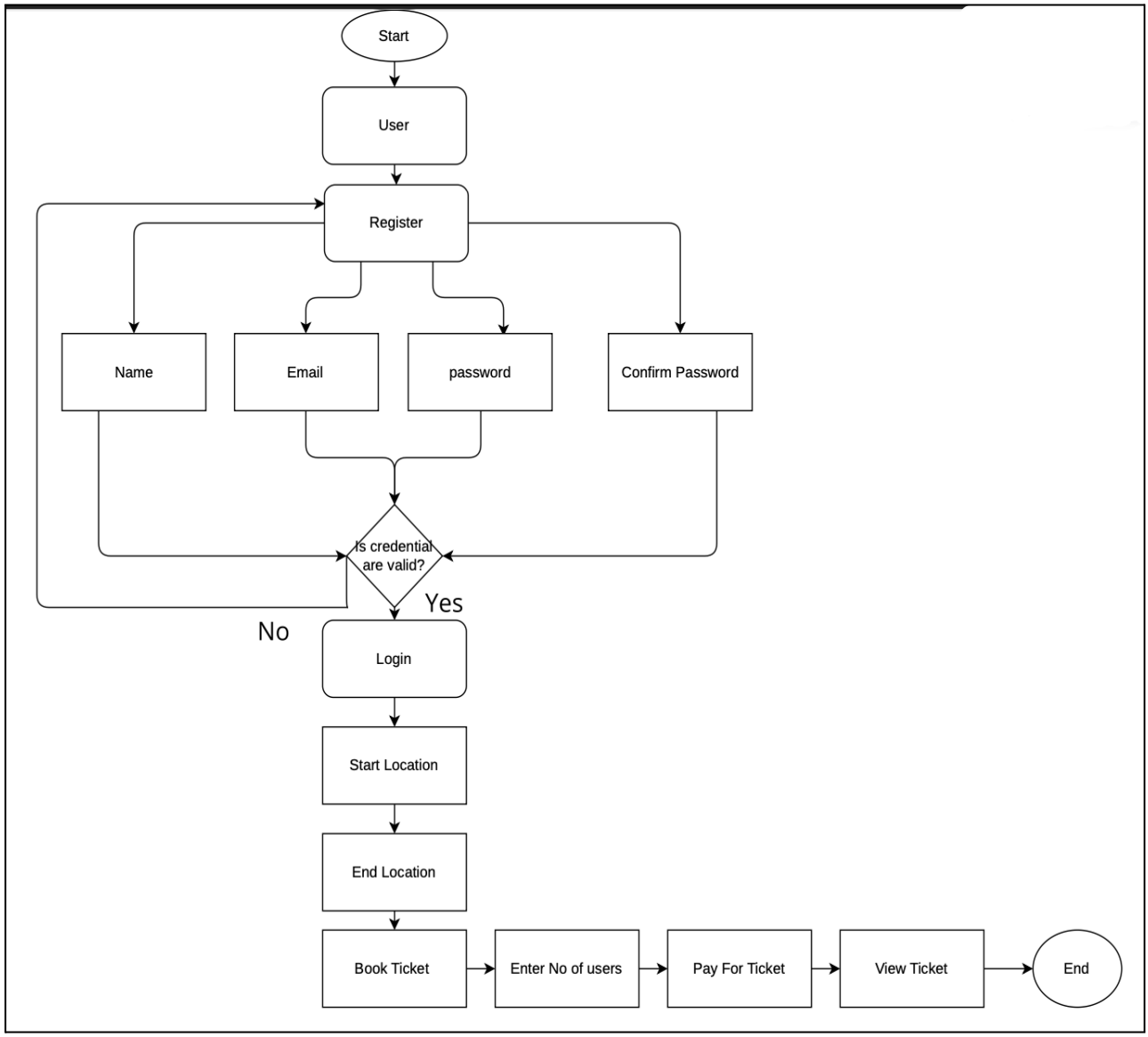

Fig. 4.6.2 flowchart (User)

Chapter 5

Project Planning

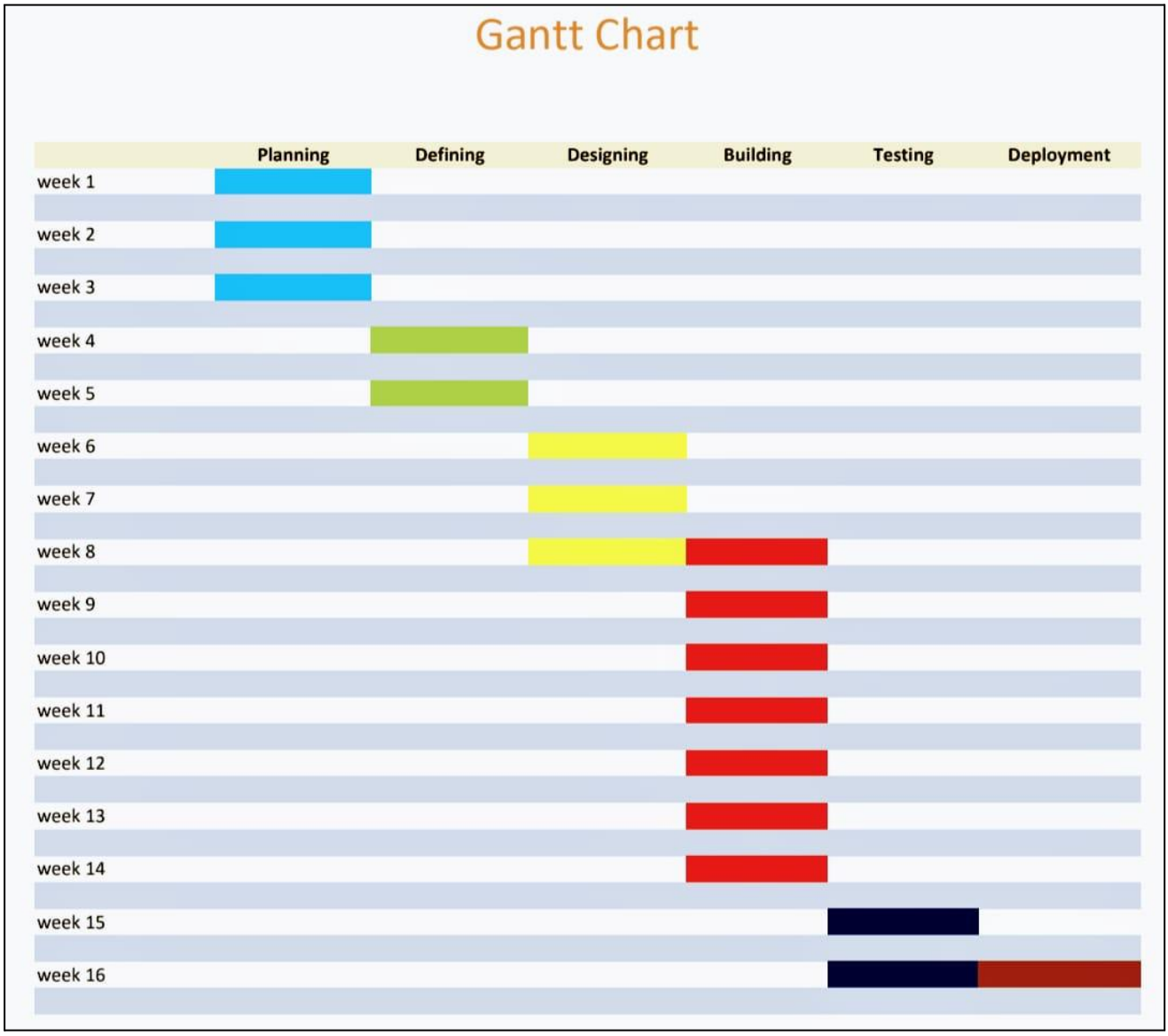

Fig. 5. Gantt Chart

Chapter 6
Experimental Setup

6.1 Hardware Requirements:

Modern Operating System:

1. Windows 7 or 10
2. Mac OS X 10.11 or higher, 64-bit
3. Linux: RHEL 6/7, 64-bit (almost all libraries also work in Ubuntu) x86 64-bit CPU (Intel / AMD architecture)
4. 4 GB RAM

6.2 Software Requirements:

- Editor used for this project is Android Studio
- Java and XML
- Firebase for Database

Chapter 7
Implementation Details

7.1 Modules :

Admin Module:

- **Add Locality:** Admin can add different localities according to the needs of the passengers along with the pincode of that location.
- **Add Buses:** Buses can be added according to the locality that has been given into the system and also the price can be set with respect to the source and destination stops.Along with the arrival time and the Departure time of the bus.
- **View Tickets:** Tickets that have been booked by the passengers with respective date can be viewed by the admin side along with the passengers travelled.

User Module:

- **Book Tickets:** Users can book his/her tickets by entering their Source Location, Destination Location, Date of Journey and search ticket according to the input given by the customer. Users can view the previously booked tickets. Also the system will display the ticket according to the input given and on clicking the ticket the user has to enter the numbers of travellers.
- **View Tickets:** Passengers are able to view the previously booked tickets along with the passengers name ,bus number and the date .

7.2 Technology Stack :

7.2.1 Frontend

XML

XML (Extensible Markup Language) can be used in an independent e-ticketing system for public transport in several ways. One common use of XML is to define the structure of data exchanged between different components of the system. For example, XML can be used to define the format of messages exchanged between a mobile application and a server that manages ticket sales and distribution.

XML can also be used to store and exchange data related to ticketing, such as ticket prices, travel routes, and passenger information. This data can be stored in XML files or transmitted over the internet using XML-based protocols such as SOAP (Simple Object Access Protocol) or REST (Representational State Transfer).

Another use of XML in an e-ticketing system is to define the structure of digital tickets. XML can be used to define the elements and attributes that make up a digital ticket, such as the passenger's name, travel date, and route information. This information can be encoded in an XML file that is stored on a smart card or a mobile device.

In addition to defining the structure of data, XML can also be used to validate the correctness of data entered by users. For example, XML schema can be used to define the structure and constraints of data entered by users during the ticket purchase process. This can help to prevent errors and ensure that data is entered correctly.

Overall, XML can be a useful tool in an independent e-ticketing system for public transport, providing a standardized way to define the structure of data, exchange data between different components of the system, and validate user input.

7.2.2 Backend

JAVA

Java is a popular programming language that can be used in the development of an independent e-ticketing system for public transport. Java is known for its scalability, security, and reliability, making it a suitable choice for building complex systems such as e-ticketing systems.

In an independent e-ticketing system, Java can be used to build the backend infrastructure that handles ticket purchases, ticket validation, and data management. Java can also be used to develop mobile applications that allow users to purchase and use tickets electronically.

Java's object-oriented nature allows for the development of modular and reusable code, which can make the development process more efficient and reduce the risk of errors. Additionally, Java provides a wide range of libraries and frameworks that can help developers build scalable and secure systems.

Java can also be used to implement real-time systems, which can be essential in an e-ticketing system that requires fast and reliable data updates. Java's support for multithreading and concurrent programming can enable the system to handle multiple requests simultaneously and maintain high levels of performance.

Overall, Java can be a valuable tool in the development of an independent e-ticketing system for public transport. Its scalability, reliability, security, and real-time capabilities make it a popular choice for building complex systems, and its rich ecosystem of libraries and frameworks can help developers build high-quality applications quickly and efficiently.

7.2.3 Database

Firebase

Firebase can be used in an independent e-ticketing system for public transport in various ways to improve the performance and reliability of the application. Here are some examples:

1. Real-time database: Firebase real-time database can be used to store ticketing information in real-time, allowing passengers to purchase and use tickets instantly. The real-time database can also be used to track the availability of tickets and update passengers in real-time about any changes in the ticket availability or fare prices.

2. Hosting: Firebase hosting can be used to host the e-ticketing application, providing a secure and scalable hosting solution without the need for server administration. This can help reduce costs and improve the performance of the application.

3. Authentication: Firebase authentication can be used to securely authenticate users and protect sensitive ticketing information. Passengers can sign in to the application using their social media accounts or other authentication methods, ensuring a smooth and secure ticketing experience.

Overall, the use of Firebase in an independent e-ticketing system for public transport can improve the performance, reliability, and security of the application, providing passengers with a smooth and seamless ticketing experience.

7.2.4 IDE

Android Studio

Android Studio is a popular integrated development environment (IDE) used to build Android applications. It can be used in the development of an independent e-ticketing system for public transport to build the mobile application that allows users to purchase and use tickets electronically.

With Android Studio, developers can create a user-friendly and intuitive interface for the e-ticketing system that is easy for passengers to navigate. The application can be built to offer features such as selecting a transportation mode, purchasing and validating tickets, checking schedules and routes, and accessing real-time transportation information. Additionally, the application can be integrated with payment gateways to enable passengers to make secure online payments for their tickets.

Android Studio also provides tools for debugging and testing the application, ensuring that it is functioning correctly and free of bugs. This can help to improve the overall quality of the e-ticketing system and ensure a positive user experience for passengers.

Furthermore, Android Studio allows developers to optimize the performance of the application by utilizing various features such as caching, background processing, and multithreading. This can help to ensure that the application is responsive and efficient, even when dealing with a large number of users and transactions.

In summary, Android Studio can be a valuable tool in the development of an independent e-ticketing system for public transport, enabling developers to create a high-quality, user-friendly, and efficient mobile application that meets the needs of passengers.

Chapter 8

Result

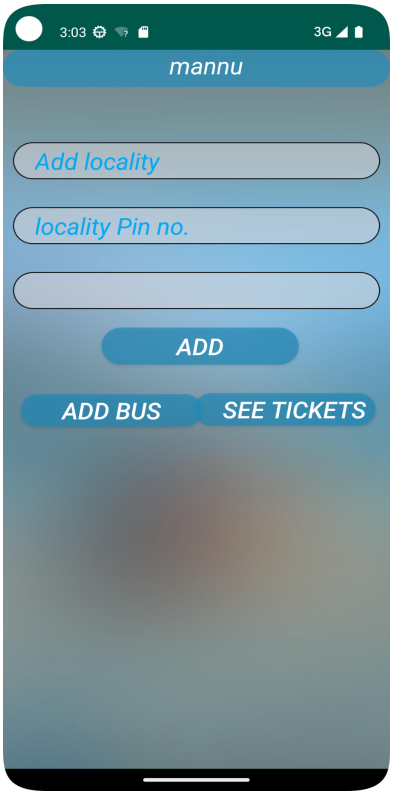

Fig. 8.1 Add Locality

The admin can add Localities.

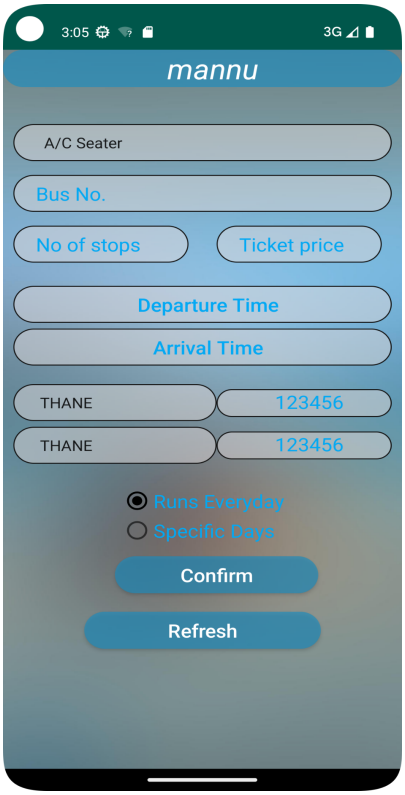

Fig. 8.2 Add Bus

The admin can add Buses.

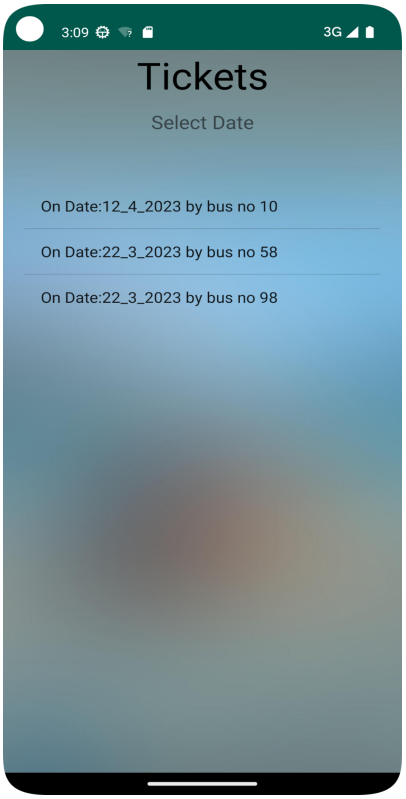

Fig. 8.3 View Tickets

The admin can view tickets booked by different users.

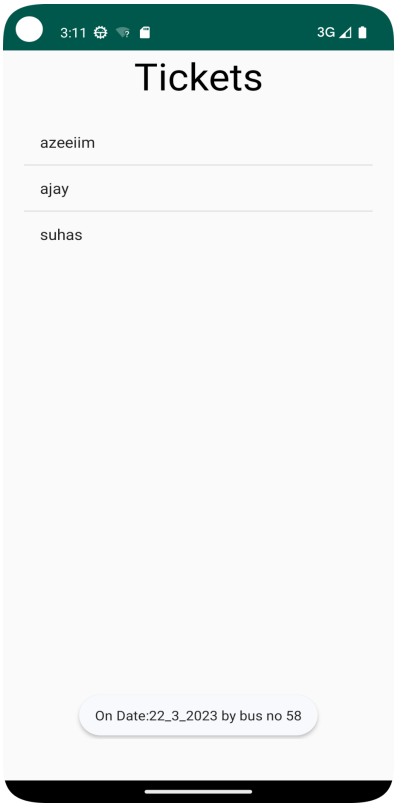

Fig. 8.4 View ticket users

The admin can view the users who booked the tickets.

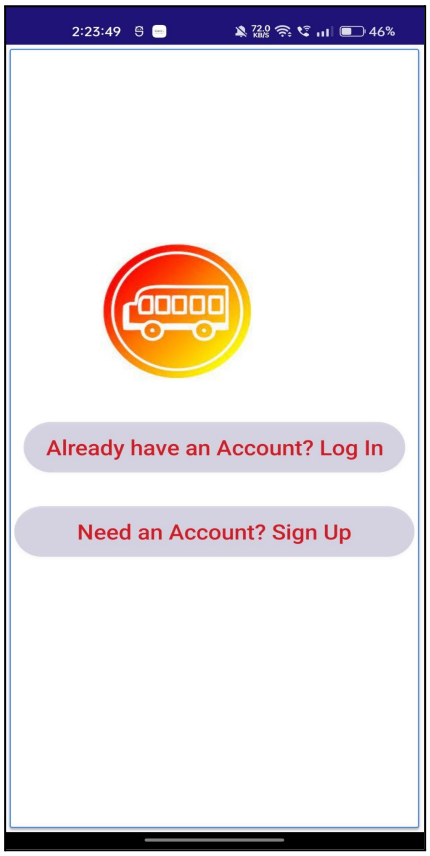

Fig. 8.5 Sign Up / Log in

The user can choose whether to sign up or login

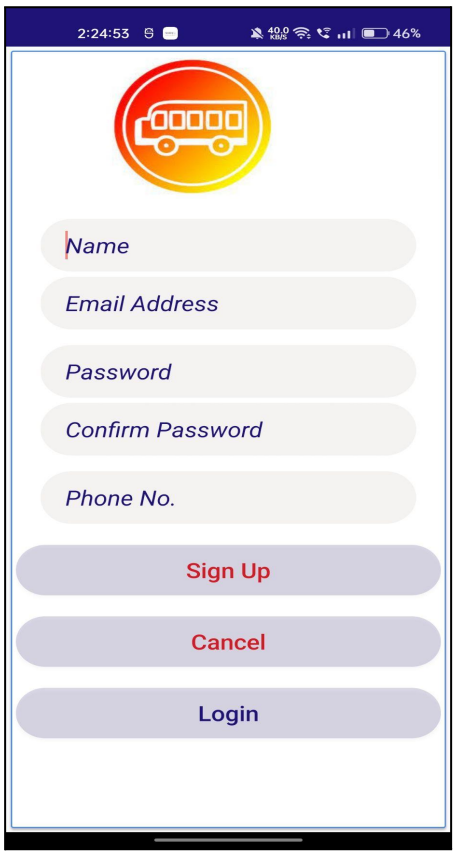

Fig. 8.6 Sign up page

The user can sign up.

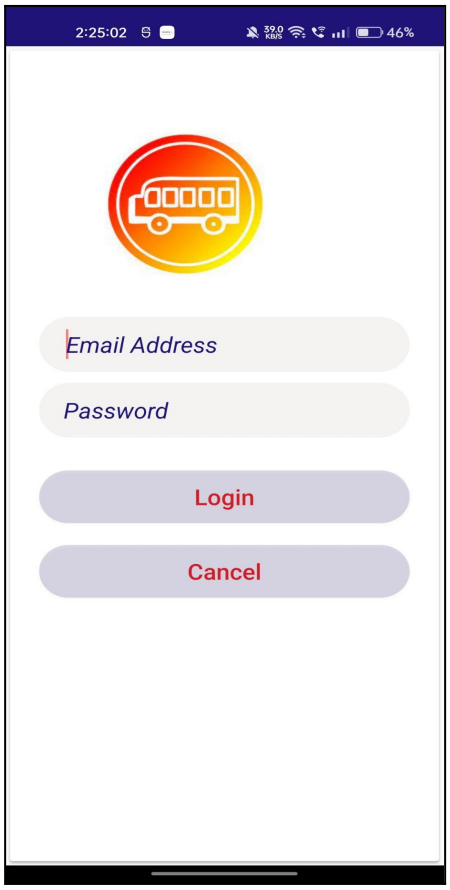

Fig. 8.7 Login Page

The user can login.

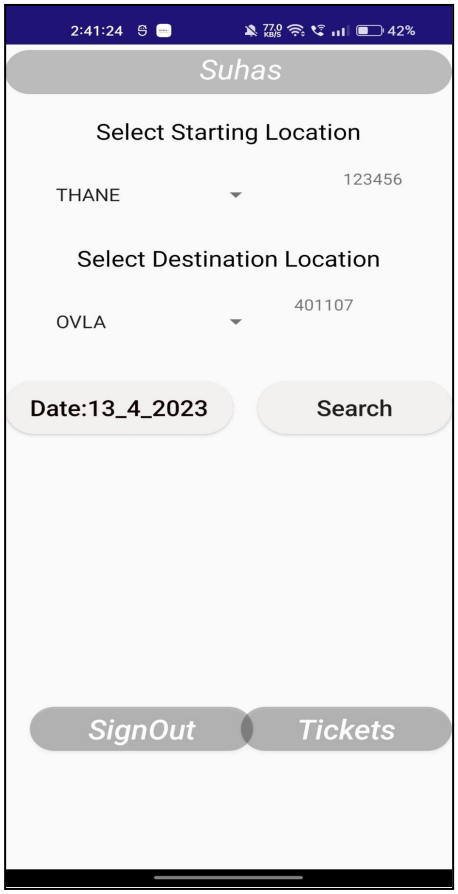

Fig. 8.8 Start stop andDestination

The user can enter the start and destination stop .

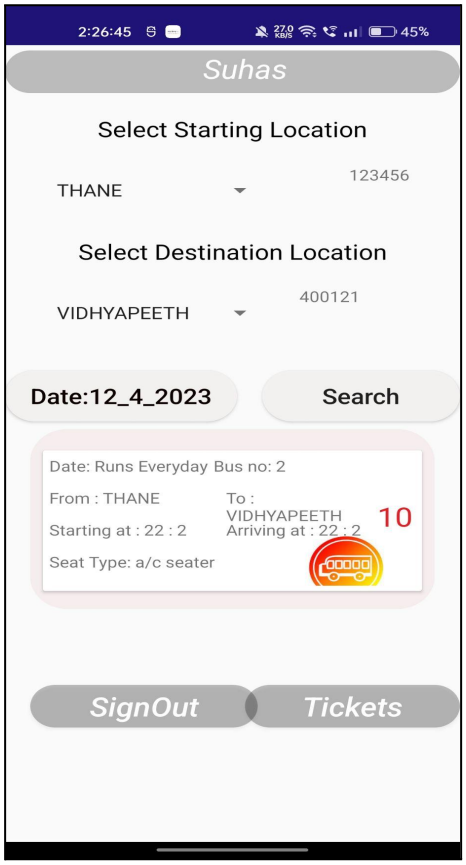

Fig. 8.9 Ticket Generated

Ticket gets generated .

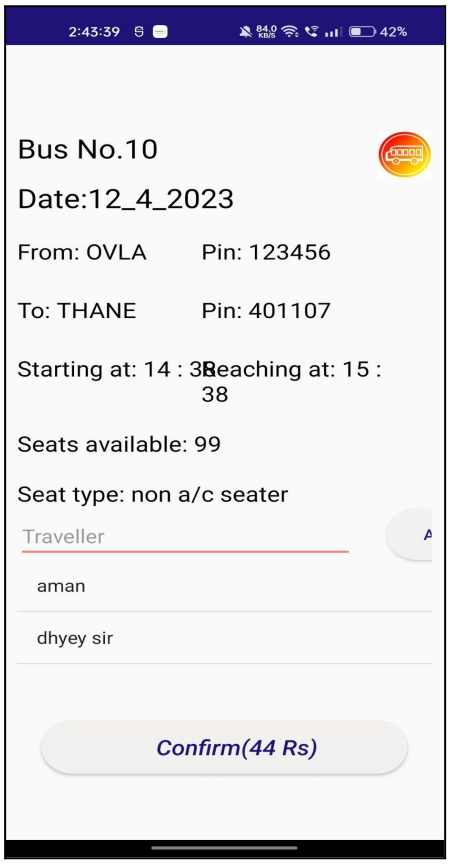

Fig. 8.10 Ticket Details

User can view the ticket details.

Fig. 8.11 View Ticket

The user can view the ticket generated.

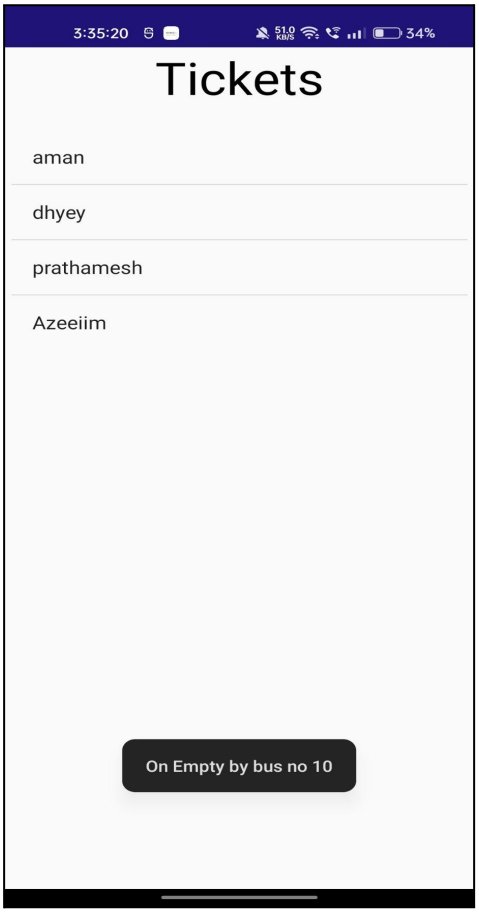

Fig. 8.12 View ticket

The user can view the details of users who bought the ticket.

```
private void calculate_price(){
    int number_of_traveller = arrayList.size();
    int Price = Integer.parseInt(ST_TicketPrice);
    int total_price = Price * number_of_traveller;

    String str_total_price = Integer.toString(total_price);

    BK_Confirm.setText("Confirm("+str_total_price+" Rs)");
}

1 usage
private void Book_Ticket(){
    if(no_of_seat<=0){
    }else{
        mauth = FirebaseAuth.getInstance().getCurrentUser();
        String User = mauth.getUid();
        Confirming_ticket = FirebaseDatabase.getInstance( s: "https://ebus-3067a-default-rtdb.firebaseio.com/").getReference().
                child( s: "Tickets").child(ST_Date).child(ST_Busnumber).child(User);
        DatabaseReference TicketID = FirebaseDatabase.getInstance( s: "https://ebus-3067a-default-rtdb.firebaseio.com/").getReference().
                child( s: "Tickets").child( s: "TicketID").child(ST_Date);
        DatabaseReference Ticket_Check_User_Admin = FirebaseDatabase.getInstance( s: "https://ebus-3067a-default-rtdb.firebaseio.com/").
                getReference().child( s: "Tickets").child( s: "Ticket_Check_User_Admin").child( s: "On "+ST_Date + " by bus no "+ ST_Busnumber);
        DatabaseReference Ticket_User_Search = FirebaseDatabase.getInstance( s: "https://ebus-3067a-default-rtdb.firebaseio.com/").
                getReference().child( s: "Tickets").child( s: "Tickets_User_Search").child(User).child( s: "On "+ST_Date + " by bus no "+ ST_Busnumber);
        DatabaseReference Ticket_HashCode = FirebaseDatabase.getInstance( s: "https://ebus-3067a-default-rtdb.firebaseio.com/")
                .getReference().child( s: "Tickets").child( s: "Ticket_HashCode").child(User);
```

Fig. 8.13. Code for Booking Ticket

This is the code for Booking tickets when the user inputs the data for booking the ticket.The code then performs the calculation in order to generate the intended price for the ticket.

Chapter 9

Conclusion

An independent e-ticketing system for public transport offers numerous benefits to both passengers and transportation providers. This digital system enables passengers to purchase and use tickets electronically, reducing transaction time and costs while improving the security of the transaction. The system operates seamlessly across different modes of public transportation, providing real-time information about transportation schedules, routes, and delays. This information can be accessed through mobile applications, websites, or on-board displays, enabling passengers to plan their journeys more effectively and avoid delays. Additionally, the system provides valuable data and insights about passenger behavior and usage patterns, which can be used to optimize transportation routes and schedules and increase revenue for transportation providers. However, implementing such a system can come with challenges, such as the need for interoperability and integration across different transportation providers and systems, and ensuring the security and privacy of passenger data.

In conclusion, the benefits of an independent e-ticketing system make it a worthwhile investment for the transportation industry. Improved passenger experience, increased revenue, and data-driven decision-making are just some of the advantages of such a system. While challenges may arise, the potential for a more streamlined and efficient transportation system is too great to ignore. The implementation of this digital system can pave the way for a more connected, convenient, and sustainable future of public transport.

Chapter 10

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Chapter 11
Acknowledgement

We have great pleasure in presenting the mini project report on “Independent E-ticketing System For Public Transport”. We take this opportunity to express our sincere thanks to our guide **Prof. T.C.Kapdi**, Department of Computer Engineering, APSIT Thane for providing the technical guidelines and suggestions regarding a line of work. We would like to express our gratitude for her constant encouragement, support, and guidance throughout the development of the project.

We thank **Prof. Sachin Malave**, Head of Department, and **Prof. Deepak Khachane**, Project Coordinator, Computer Engineering, APSIT for his encouragement during the progress meeting and for providing guidelines to write this report. We also thank the entire staff of APSIT for their invaluable help during this work. We wish to express our deep gratitude towards all our colleagues at APSIT for their encouragement.

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